THE

Malayan Agricultural Journal.

Vol. XII. January, 1924. No. 1.

CANDLE-NUT AND CHINESE WOOD OIL TREES.

By W. N. Sands.

THE Department of Agriculture has received enquiries from time to time from local planters who were desirous of obtaining information concerning the possibility of cultivating successfully in Malaya the Candlenut and Chinese Wood Oil Trees.

As so much confusion exists in the botanical and chemical literature concerning these trees and the oils produced by them, it is thought that the following information derived from the publications named at the end of this article and from notes made on the species growing locally, may be useful for reference purposes.

The genus *Aleurites* to which all the trees belong is included in the Natural Order: *Euphorbiaceae*. There are five species of economic value namely, *Aleurites triloba, Forst*; *A. Fordii, Hemsl.*; *A. montana, Wils.*; *A. cordata, R. Br.*, and *A. trisperma, Blanco*. The synonymy of certain of these is too long for inclusion here, but the chief synonyms are included in the detailed description of each tree given below.

1. *Aleurites triloba, Forst*: (*syn. A. moluccana, Willd.*) = Candlenut, Indian Walnut, Kemiri Nut, Kekuna Nut, Merikin Nut, Buah Keras, Lumbang and Country Walnut Oil Tree.

This species is native of Malaya and Polynesia. It has been widely distributed and is now naturalized in most tropical countries. Locally the tree occurs principally in the coastal districts of Pahang. It has also been planted on a small scale on two or three estates and there are indications that the tree will grow and fruit well under plantation conditions.

The tree is evergreen and reaches a height of 40 to 60 feet. The shoots and leaf-stalks are covered with short stellate downy hairs. The leaves are alternate with long petioles and vary considerably in shape. The younger leaves and those on vigorous shoots are palmately three to seven lobed with a broad open base, whereas the leaves on fruiting branches of older trees are usually much smaller, quite entire and ovate to lanceolate in shape.

The inflorescence is cymose and much branched with small flowers on short stalks. The sepals are velvety usually splitting into three lobes or segments. The five petals are white and bearded within. The stamens which number 15 to 20 are borne on a hairy receptacle and have short hairy filaments.

The fruit is sub-globose, 2-2½ inches in diameter, smooth, olive-coloured and shortly pointed. The husk is thin, fleshy, soft and encloses 1 to 2 large seeds each about 1¼ inches long and 1⅛ inches broad with a thick very hard and roughly furrowed seed-coat. The fruit matures in about six months after the opening of the flower.

The tree usually starts to flower, under suitable conditions, in three to four years from the time of planting.

The kernel of the nut contains 50 to 60% of oil which is used by the natives for illuminating purposes, hence the name 'Candle-nut.' The oil is allied in composition to Chinese Wood Oils, but is not as good as these in quality, and like them is inferior to linseed oil when used in paints and varnishes.

The oil is not edible, and further, the meal derived from the kernels after the oil has been extracted has strong purgative properties.

2. *Aleurites Fordii. Hemsl.* (*syn. A. cordata. Meull., Dryandra oleifera, Wall., Elaeococca verrucosa Adv. Juss.*) Chinese Wood Oil. Tung-yu (Tung Oil Tree).

The habitat of this tree is in the warm temperate parts of China, more especially the water-shed of the Yang-tze River. It also occurs in Fokien and Yunnan. It is a quick growing, much branched short-lived tree, and seldom exceeds 30 feet in height. It is highly ornamental when in flower.

Frequent attempts have been made to cultivate this valuable species at low elevations in the tropics, but as far as is known no success has been recorded. It is said to have been successfully acclimatized in the Southern Shan States between 1,500 to 2,000 feet altitude, and to some extent in Burma, Assam, Nepal and Sikkim. The tree also thrives in the Southern United States of America. A small area has recently been planted with this species on an estate in Negri Sembilan, but judging from previous experiments with this tree it is not likely to grow well in Malaya at elevations below 2,000 feet.

The leaves are deciduous, dark glossy green, broadly ovated, heart-shaped and long pointed. The blade of the leaf is 4 to 6 inches or more long and broad. The leaf stalk is about 6 inches long. On young trees and vigorous, but usually sterile shoots, the leaves are three-lobed.

The inflorescences are terminal and axillary, much branched and form at the end of each shoot a loose rounded mass.

The flowers are 1 to 1½ inches wide, white tinged with pink and yellow markings more especially near the base.

The fruit is green passing to dull brown when ripe. In shape it is flattened, rounded and somewhat top-shaped, 1½ to 2 inches long and broad with a short stout point at the summit. The husk which is thin and opens from the base upwards encloses from three to five, rarely more, compressed broadly obovoid seeds each ¾ to 1 inch long and broad, very slightly ridged and warty on the surface and with a thin shell.

Although the fruit opens naturally it is rarely allowed to do so by the Chinese who collect it before it is ripe and allow it to ferment in grass or straw covered heaps. The husk being thin, it is easily destroyed by fermentation in these heaps and the seed is readily removed.

In the Shan States the tree comes into bearing in 8 to 10 years from the time of planting.

In China it is the best oil producing species. It is estimated that nine-tenths of the wood-oil exported from that country is derived from it; moreover, the oil is especially valuable for use in paints and varnishes although not superior to linseed oil.

Both the fruit and seed are poisonous to man and cause vomiting and purging when ingested.

3. *Aleurites montana, Wils.* (*syn. A. cordata, R. Br., Dryandra oleifera, Lam.*) Chinese Wood Oil, Mu-yu Shu. (Wood Oil Tree).

This tree is found in the South-eastern parts of China from the province of Fokien southward to Tonking. It requires a sub-tropical climate and a more abundant rainfall than the northern species *A. Fordii*. The tree is said to resemble closely in size, habit, foliage and general appearance, but not in its flowers and fruit, the Tung-yu Shu (*A. Fordii.*)

In the Kuala Lumpur Experimental Plantation there are two plots of *A. montana*, now 3½ years old, which were derived from seed obtained from Hong-Kong. The trees have made strong healthy growth although planted on a steep hillside in poor sandy soil. Some of these are now from 12 to 15 feet high, but all the leaves are still deeply palmately five-lobed and in this respect are quite distinct from juvenile leaves of *A. Fordii.**

It is evident that the species can withstand a much warmer climate than *A. Fordii.* and it gives indications of thriving as well in Malaya as the local species, *A. triloba.*

---

* Towards the end of December, and since the above was written, several trees of *Aleurites montana* in the Kuala Lumpur Plantation started to flower. The flowers are white, 1½ inches in diameter, and are borne in large terminal showy masses. Most of the leaves of the flowering shoots are quite entire and heart-shaped, but some of them are three to four-lobed.

The inflorescence consists of a terminal corymb or a raceme and is produced on shoots of the current season's growth after the leaves have fully expanded. The male inflorescence is many flowered, much branched, 6 to 8 inches long and 8 to 12 inches broad. The female inflorescence is racemose, relatively few flowered, and only 3 to 4 inches long.

The fruit is egg-shaped, $1\frac{3}{4}$ to 2 inches long and $1\frac{1}{2}$ to $1\frac{3}{4}$ inches broad. It is pointed at the summit and flattened at the base. There are three prominent longitudinal and several transverse raised ridges on it. The husk of the fruit is hard and woody and usually encloses three compressed, broadly ovoid, seeds each about $1^1/_5$ inches long, 1 inch wide and warty on the outside. The fruit opens from the base upwards into three parts so that the seeds can be easily extracted. Since the husk of the fruit is hard and comparatively thick, it is not easily destroyed by fermentation as is the case with the Tung-yu fruit derived from *A. Fordii*.

The oil is said to be similar in composition and value to that derived from the Tung-yu seed; but the exports of it are small. Owing to the botanical confusion which has existed, the oil has not been clearly distinguished from the oils obtained from the Tung-yu (*A. Fordii*.) and the Japanese species, *A. cordata*.

4. *Aleurites cordata, R. Br.* (*syn. Dryandra cordata, Thunb. D. oleifera, Lam.* and *Aleurites japonica, Blum.*) Japanese Wood Oil. Abura Giri, Abrasin.

This species occurs in Southern Japan and has been confused with the Chinese species. It is similar in size, habit and foliage to the Mu-yu (*A. montana, Wils.*) Like that tree it produces its flowers at the end of the current season's growth after the leaves are fully expanded. The leaves on flowering branches are often three-lobed.

The inflorescence is an erect cymose panicle and there is a decided tendency towards separate male and female panicles, but these are produced on shoots growing close together on the same branch. The flowers are rather smaller than those of *A. montana*.

The fruit is rounded somewhat top-shaped and three-angled. It is about $\frac{1}{2}$ inch long and $\frac{3}{4}$ inch wide, flattened and slightly depressed at the summit. It tapers slightly to the stalk and possesses three small longitudinal ridges and several small irregular transverse ones. The husk is thin, soft and fibrous and encloses 3 to 5 seeds which are smooth, compressed, sub-globose and about $\frac{1}{2}$ inch long and broad. The fruit and seed are therefore much smaller and quite distinct from any other species.

The oil is not an article of regular export to Western countries, but is used chiefly by the Japanese as an illuminant. It is similar in composition to Candle-nut oil and could probably be used for similar purposes.

5. *Aleurites trisperma, Blanco.* (*syn. A. saponaria, Blanco*)—Balucanag, Balucanah, Calumban.

This tree like *A. triloba* is a tropical species found in the Philippine Islands, but not, as far as is known, in a truly wild state.

Unlike the previous species described, the leaves of this tree are quite entire in all stages of growth, heart-shaped, pointed and glabrous.

The flowers are smaller than those of *A. Fordii* and *A. montana* but the fruit is larger. In shape the fruit resembles that of *A. montana* being oval and pointed about 2½ inches long and nearly as broad. The husk is thick, hard and somewhat rough on the surface. The seed is large, smooth, oval to round in shape, up to 1¼ inches long and almost as broad; it is slightly flattened and compressed along the inner side. The shell is thin and brittle.

The oil from the seed is said to be poisonous but to possess good drying properties.

Aleurites oils, other than those from the two Chinese species, are not well known in Western markets, but if these were exported in quantity at regular intervals, manufacturers of soft-soap, oil varnishes, paints and other articles such as linoleum, would no doubt become interested in them. It would appear, however, that the demand for and market value of them will always be regulated by the supply and price of linseed oil to which all are somewhat inferior.

It is hoped that the above notes on the different species of Aleurites will assist those who are interested in them to identify them.

The plates numbered 1 and 2 show the chief characters of the fruit and seed of each tree at approximately natural size.

Mr. E. H. Wilson of the Arnold Arboretum kindly supplied the specimens of the fruit, and seed of *Aleurites Fordii*, *A. montana*, and *A. cordata;* whilst fruit, seed and leaves of *A. trisperma* were supplied by the Director of Agriculture, Manila, Philippine Islands. Our thanks are also due to Mr. W. Popenoe, Agricultural Explorer of the United States Department of Agriculture, for a valuable collection of photos of growing trees, fruit and seed of all the species.

References.

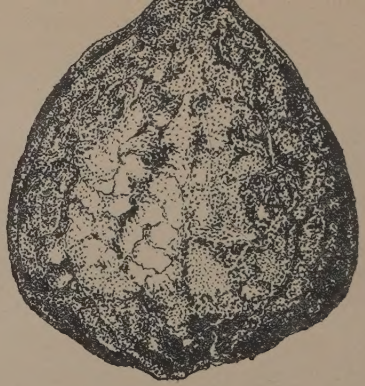
1. J. D. Hooker ——— 1875 — Aleurites moluccana—Flora of British India, Vol. 5, pp. 384--385.

2. J. M. H. W. B. H. ——— 1906 — Chinese Wood Oil (Aleurites Fordii and other species of Aleurites)—Bulletin of Miscellaneous Information, Royal Gardens, Kew., No. 4, 1906.

3.	W. B. H. ——— 1908	Aleurites trisperma—Bulletin of Miscellaneous Information, Royal Gardens, Kew., No. 2, 1908.
4.	—— ——— 1914	The Wood Oil Trees of China and Japan—Bulletin of Miscellaneous Information, Royal Gardens, Kew., No. 1, 1914.
5.	E. H. Wilson ——— 1913	The Wood Oil Trees of China and Japan—Bulletin of the Imperial Institute—1913, pp. 441—461.
6.	J. H. H. ——— 1917	The Candle-nut or Indian Walnut—Bulletin of Miscellaneous Information, Royal Gardens, Kew., Nos. 9—10, 1917.
7.	B. J. Eaton ——— 1919	Tung Oil or Chinese Wood Oil and Candle-nut oil from Aleurites species—Agricultural Bulletin, F.M.S., Vol. VII, No. 3, 1919.
8.	C. D. V. Georgi ——— 1922	Oil from Aleurites Species—Malayan Agricultural Journal, Vol. X, No. 8, 1922.
9.	B. J. E. ——— 1923	Candle-nut oil from Aleurites moluccana—Malayan Agricultural Journal, Vol. XI, No. 5, 1923.

Received for publication July 31st, 1923.

A



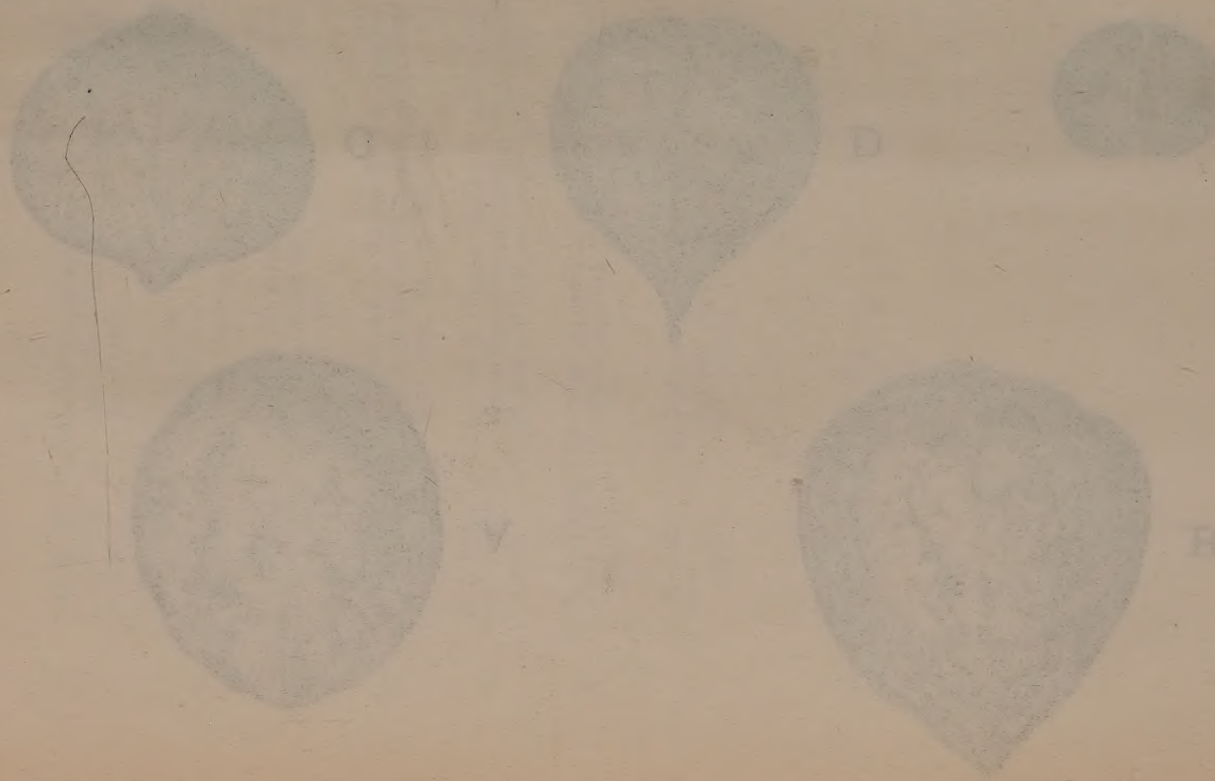
B

C

D

E

Plate I. — Fruit of Aleurites. — A. A. triloba; B. A. trisperma; C. A. Fordii; D. A. montana; E. A. cordata.

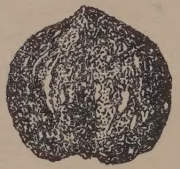

C
D
E
A
B

C
D
B
A
E

A

B

C



D

E

Plate II. — Seed of Aleurites. — A. A. triloba; B. A. trisperma; C. A. Fordii; D. A. montana; E. A. cordata.

THE UTILISATION OF CITRONELLA GRASS PLANTED AS A PREVENTIVE OF SOIL WASH.

By C. D. V. Georgi.

CITRONELLA grass is frequently planted on hilly land as a preventive against soil wash and as this grass contains an essential oil (Citronella oil) for which there is a constant demand, many estates have considered recently the possibility of utilising such grass for the preparation of the oil.

Several determinations of the oil content of grass from such estates have been carried out, while, in addition, a considerable quantity of the oil from the grass growing under similar conditions on Government Plantations, has been prepared and sold on the London market. It is thought therefore that the publication of the results of these investigations will be of interest.

Varieties of Grass.

Citronella grass belongs to the genus Cymbopogon (Natural order Gramineae) to which natural order certain other so called aromatic grasses belong, such as Lemon grass, Palmarosa grass and Ginger grass, all of which are similarly distilled for their essential oils. Although botanically there are doubtless several varieties of this grass, from the cultivation point of view there are only two, namely *Cymbopogon Nardus*, Rendle, known as *lena-batu* and *Cymbopogon Winterianus*, Jowitt, known as *Maha Pengiri*.

The former variety Cymbopogon Nardus, Rendle, occurs chiefly in Ceylon, while *Cymbopogon Winterianus*, Jowitt, which yields the so-called Java Citronella oil, would appear to be the variety common in this country.

Cultivation of Grass.

Citronella requires a hot damp climate and therefore grows well in this country, but it must be remembered that, if the grass is to be cultivated both as a preventive against soil wash and as an economic crop, it will require more attention than is usual at present, where it serves only the former purpose.

The grass should be cut at least twice a year, it should never be allowed to flower or become rank, since the oil content is greatest in the young leaves. The stalks contain practically no oil. Care should be taken to clear out the stumps after cutting so as to allow free growth for leaves.

A light changkolling in order to ensure a certain amount of tilth, is also beneficial, while if possible, the exhausted grass (after extraction of the oil) or its ashes (after being burnt under the boiler) should be turned in round the plants.

This exhausted grass has a considerable fertilising value as the following table giving the results of analysis of a locally grown grass shows :

	Per cent.	Per cent (on dry).
Moisture	- 10.7	—
Ash	- 5.0	5.6
Organic and Volatile matter	- 84.3	94.4
Nitrogen	- 0.98	1.11
Potash (as K_2O)	- 1.10	1.23
Phosphoric Acid (as P_2O_5)	- 0.12	0.13

It has been noticed that the oil output diminishes with the age of the plant, so that a stage is reached when it is no longer profitable to extract the oil, and in countries where Citronella grass is cultivated solely for its oil content it is customary to replant fields about every ten years. In cases where this grass has been planted on terraces between young rubber this stage would be reached much earlier, probably in 5 to 7 years, as the shade afforded by the trees would affect the growth of grass considerably. Citronella grass will not thrive under heavy shade, it requires sun for its development.

Outline of Process for Extraction of Oil.

The process by which the oil is extracted from the grass is simple, it consists in a steam-distillation, that is to say, steam is passed through the grass when the oil is volatilised and carried over by the excess of steam. The mixed vapours are condensed, when the oil, being lighter than the water, rises to the surface and can be separated.

Preliminary treatment of Grass.

The grass is not distilled when freshly cut, but is allowed to dry for a few days. The oil content is not affected to any extent, provided that, during the period of drying, the grass is kept spread out. If the grass be piled, heating and fermentation will ensue, affecting both the quality and quantity of the oil.

The advantages to be gained by this preliminary drying are firstly, on account of reduction in volume on drying, a much larger equivalent quantity of grass can be packed into the still and secondly the diminution of the moisture content results in a considerable saving of fuel. Further, it has been noticed that, when distilling dried grass as compared with fresh grass, the oil seems to separate more easily from the water ; when distilling fresh grass a certain quantity of gummy matter appears to pass over with the oil, which retards the separation.

With regard to the loss of moisture which Citronella grass undergoes during drying, experiments have shown that, drying under an attap shed and with normal weather conditions, the loss in weight after 4—5 days is between 60 and 65 per cent.

Extraction of Oil.

The site selected for the erection of the plant for extracting the oil must be close to a regular water supply, as the success of the operation depends to a very large extent upon the efficient condensation of the mixed oil and water vapours.

The plant required consists of three parts (*a*) a boiler for raising steam, (*b*) a still in which the dried grass is packed, (*c*) a condenser in which the mixed vapours of steam and oil are condensed.

The boiler is not required to work at high pressure, about 15 lbs. is sufficient as a working pressure. If high pressure steam is used it will be found that the grass becomes black and the oil is dark in colour. The still is usually made of cast iron and is provided with a perforated plate on which the grass is packed and through which the steam passes. The top of the still should be so arranged that it can be opened easily to admit of rapid emptying and filling. In some installations several small stills, all mounted on trunnions, are used in place of one large still in order to facilitate these operations. In that case all the stills are connected to the main steam pipe and the main condensing pipe. A cheap and effective condenser can be made by fixing a coil of tin pipe in a large barrel through which cold water circulates, or, for a small installation, the barrel may be replaced by a large oil drum.

As regards fuel, once the fire has been started it can be maintained by using as fuel the dried exhausted grass from previous distillations. In a series of experiments carried out recently it was found that in this way a reduction in the quantity of wood required could be effected up to between 50 to 60 per cent.

The time of distillation will depend upon several factors, such as the size of the still, and can only be determined as a result of experiment. In a series of experiments similar to those referred to in the previous paragraph it was found that, with a boiler steam pressure of between 15 to 20 lbs., the distillation of about 1 picul of dry grass was completed in about $1\frac{1}{4}$ hours.

It is important to see that the condenser is effective, so that the vapour of the oil remains in contact with steam for as short a time as possible. With efficient condensation the separation of the oil and water is rapid and can be effected mechanically in a Florence flask or, if this is not available, the mixture of oil and water can be run into a large container, the water being run off, leaving the oil behind.

After separation from the water, the oil requires no further treatment beyond filtration through thin blotting paper or a double thickness of fine muslin to remove any sediment, after which the oil is ready to pack into tins or drums for export. The colour of the oil varies from a yellow to a yellowish brown, due to the iron of the still. If the grass be treated in an enamel still or one lined with tin the oil is practically colourless.

Yield of Oil.

As a result of several determinations it appears that the average yield of oil on grass cut regularly is about 0.5 to 0.6 per cent by weight, that is, one ton of fresh grass gives 11 to 13 lbs. of oil. In some cases a yield of 0.8 per cent on the fresh grass has been obtained, but this figure is considered somewhat exceptional, while, as an example of the diminution in yield of oil if the grass be allowed to become rank, it may be stated that as a result of experiments made with grass which had not been cut for 18 months the yield of oil was found to be only 0.3 per cent by weight.

When planted as a sole crop the yield of fresh grass per acre appears to be about 5 tons, so that about 60 lbs. of oil per acre may be expected at each cutting.

Value of Oil.

Chemical analyses of oil distilled from local grass have shown that this is equal in quality to Java oil, as will be seen from the figures given in the following table:—

	Local oil.	Java oil (average).
Density (15.5°C) ...	0.8852	0.884 —0.900
Refractive index (20°C) ...	1.4678	1.4650—1.4720
Acetylisable content (calculated as Geraniol) ...	88.9%	85—96%
Miscibility with 80% Alcohol (Schimmel's test) ...	Miscible, but when diluted to 3 vols., slight opalescence.	Miscible, a slight opalescence is permitted.

Further, during the latter part of 1921 a large quantity of grass, planted as a preventive of soil wash on the Government Experimental Plantation at Batu Tiga, was collected and distilled, about 20 lbs. of oil being despatched for sale on the London Market. The oil when sold about the end of December 1921 realised 2/6 per lb. nett, the price then prevailing for Java oil. An extract from the buyer's letter is appended:

> "With reference to the small lot of Malay Citronella Oil, which you sold me the other day, I would say that this is an excellent quality, quite equal to the best Burmese oil, and if your people can continue to supply an equal quality, distilled in just the same way as these 20 lbs. were distilled, there is no reason why they should get any less money for it, than is generally obtained for good Burmese oil."

Since the date of that letter the price of such Citronella oil has appreciated steadily, until now it stands at about 4/- per lb.*

The latest price (December 1923) is 4/8 — 4/9 per lb.

Conclusions.

The results of these investigations show that the extraction of the oil from the grass is a simple operation. The plant required is also comparatively inexpensive, and can be improvised easily. Further, with the oil standing at its present price and a supply of grass sufficient to maintain a still more or less continously in operation, there should be a fair margin of profit.

It is recommended however that as far as possible the plant be an improvised one, as it should be borne in mind that, when Citronella grass is planted as a soil wash preventive on hilly land, between say young rubber or other crops, which will eventually give shade, the yield of oil will begin to diminish after a few years, until a stage is reached when, owing to the increased shade, it will be no longer profitable to distil the grass. Under those conditions the estate will not be left with an expensive plant for disposal.

Received for publication July 16th, 1923.

A REVIVAL OF PATCHOULI CULTIVATION IN JOHORE.

By A. E. C. Doscas.

THE decline of Patchouli cultivation owing to over-production, and the increasing popularity of *Hevea brasiliensis*, removed from Johore for many years an industry which at one time was of considerable importance. Within the last few months however, a good deal of attention has been attracted towards the cultivation of this crop and there are indications of a gradual resuscitation of the industry.

Enquiries have lately been received from several sources, and its sporadic cultivation on a small scale led Mr. Low Ting Teng to instal in his pine-apple factory a small plant for the distillation of the oil. This combination, however, carried with it several obvious disadvantages, and Mr. Teh Keng Siow who is going in for cultivation on a large scale on his estate in Johore Bahru took over the plant, and had it erected on his property.

Patchouli (*Pogostemon patchouli*) is a small herbaceous plant, with flaccid leaves and stems, which on distillation yield an essential oil from which Essence-of-Patchouli is prepared. Patchouli perfume is popular in Europe and India, and is largely used in the preparation of other perfumes.

Propagation is carried out by means of cuttings, which are set out in nursery beds previously prepared. The young shoots require careful attention, a little shade, and plenty of water until properly established, when they may be planted out in the field.

Low, somewhat moist land, appears to give good results. The plants are set out in rows three feet apart, with about three feet separating each plant in the rows. In good soil growth is fairly rapid, the plants become very much branched, and usually attain a height of three feet. During the growing period the land requires constant weeding, and a little light cultivation is well repaid.

When fully grown, which is usually at about six months, the leaves and stalks are cut a little distance above the ground, tied into bundles, and removed to the drying ground near the storage sheds. Here they are spread out in a thin layer on a concrete bed or other hard dry surface, and allowed to become thoroughly sun-dried. The mass is constantly turned over by means of sticks to obtain even and thorough drying, and to prevent fermentation which would be extremely detrimental to the oil. When thoroughly dry the whole is stored preparatory to distillation.

Cultivated on good land, Patchouli may yield three cuttings (the first giving roughly ten pikuls of leaves per acre) before re-planting is

Cultivation of Patchouli.

Drying of Patchouli.

necessary. It is understood that subsequent plantings on the same land are accompanied by a marked deterioration in the crop. In the event of the industry showing any signs of becoming sufficiently profitable, investigations in crop rotation may be desirable.

In the matter of distillation, advantage is taken of the fact that the oil is volatile, and the dried matter of the plants is placed in a closed iron still holding about one and a half pikuls of material. Steam from a boiler is driven into the mass through a hole in the bottom of the still, and emerges through a pipe from the top and is led into a spiral coil pipe submerged in water where the steam charged with the vapour of the oil condenses and the whole runs off into a collecting vessel. From the bottom of this vessel an overflow pipe is taken to a point a little distance below the rim, and through this pipe the water from the bottom is led away leaving the oil in an impure state floating on the surface. Further distillation and refining is necessary before the oil is exported.

One pikul of dried material yields about two pounds of oil, the present price of which is seven to eight dollars per pound.

The plate opposite shows the plant in the field, and the leaves and stalks in the drying yard.

Received for publication August 8th, 1923.

NOTES.

AVOCADO OR ALLIGATOR PEAR.

The Avocado pear is little known in the Malay Peninsula. Many people who are familiar with it consider the fruit a great delicacy and it is to be hoped that the tree, which is well suited to Malayan conditions, will soon be more generally cultivated throughout the Peninsula. A few Europeans are growing it, but it is practically unknown to the Asiatic population of this country.

The common Avocado of America is a native of Mexico and Tropical America and is grown commercially in the West Indies, Brazil, California, the Philippine Islands, and several other tropical and sub-tropical countries. It is reported that this fruit takes the place of meat, to a certain extent in the dietary of the Central Americans and there is every reason to believe that eventually the Avocado will be as familiar to American housewives as the banana is to-day.

The tree belongs to the Natural Order Laurineae. There are many species and varieties of *Persea*. The tree cultivated here is a variety of *Persea gratissima*, *Gaertn.* which is synonymous with *P. americana Mill.* The tree reaches a height of about 25 to 30 feet in this country and has large pear shaped fruits. A considerable variation in the size of the fruits has been noticed which is no doubt due to soil conditions and soil treatment. The fruit grown locally is green in colour and is harvested one or two days before it is fully ripe when it should be stored in a cool dry place until it is slightly soft to the touch, then it is ready for consumption. The pulp is fairly firm when not over-ripe and of the consistency of fresh butter, hence the name 'Midshipman's butter' for the fruit in the West Indies. It is yellowish in colour with a delicate nutty flavour.

Seeds of the Avocado pear were received from Trinidad in October, 1909, and the seedlings planted at Kuala Lumpur and Batu Tiga Experimental Plantations in the early part of 1910. The trees grew extremely well and in the fifth year attained a height of about 20 feet when they commenced to bear fruit. The soil on which they are growing is a poor laterite one and given more favourable soil conditions there is no doubt whatever that the trees would reach maturity at an earlier age, would produce larger fruits and a heavier crop.

The Avocado may be easily raised from seed and the results obtained by the writer from this method of propagation are satisfactory, although in the commercial growing of this crop it is advisable to propagate the tree by budding or grafting in order that the fruit may be uniform in quality. Seed should be selected from the best trees yielding the largest and most uniform fruits. As the seeds retain their germinating power for a short period only it is essential to plant

them as soon as possible after the fruit has been consumed. A satisfactory method is to sow the seeds singly in bamboo pots which contain a light friable soil, care being taken to ensure that the pot has good drainage. The seeds are planted in such a way that the pointed end is level with the surface of the soil. The seedlings are kept under shade until ready for transplanting which takes place in from two to three months from the date of seed sowing. The seedlings transplant well, but it is recommended to provide a little shade until the plants have recovered from the operation. The distance of planting is about 20 by 20 feet. It would appear that the Avocado will thrive in a variety of soils but a rich friable loam will, in all probability, give the best returns. The tree responds well to cultivation and manuring. Light tillage around the trees should be carried out at intervals of six months and manuring with organic manure, once a year. On no account should lalang be allowed to grow in the orchard.

The Avocado can be grown successfully in the plains in this country and there is every reason to believe that it will thrive on the hills. Good growth has been obtained from a plant growing at Ginting Simpan at an elevation of over 2,000 feet. In Ceylon the tree is stated to thrive best at medium elevations.

At the Experimental Plantation, Kuala Lumpur, over 100 fruits have been obtained from 6 to 7 years old trees but as already stated this yield could no doubt be increased if grown on better quality soil.

The fruit may be consumed in a number of ways—as a dessert, a salad, in soup and ice-cream.

In the International Review of the Science and Practice of Agriculture, Vol. I, No. 2, April—June, 1923, page 407, it is reported in connection with Fruit Growing in Brazil that "The following species are to be recommended for industrial cultivation: the Avocado (*Persea gratissima*), a native of Brazil, where it reaches the height of 15 m. in the fifth year after sowing, and begins to bear when 5 or 6 years old. In the extreme north of Brazil, this tree produces two crops annually, and a fine specimen yields 600 to 700 fruits a year from its seventh year. The fruits can be kept in cold storage for over 30 days."

The following is an extract from the Report of Administrator for the year ending 30th June, 1922. The Parliament of the Commonwealth of Australia, Northern Territory. Annual Report of the Superintendent of Agriculture and Curator Botanic Gardens.

"*Fruits.*—Some Avocado pear trees (*Persea americana, Mill*) raised from seed obtained from the Philippine Department of Agriculture have been planted out, and are now well established, and giving every indication of health. This fruit has not previously been grown in the Northern Territory. It is of great importance, being a valuable food, and it is said to contain a higher protein content than any other fresh fruit. Its chief value, however, is due to its high content of fat.

In view of these facts it is gratifying to be able to report well on the growth of the trees to date, and efforts will be made to obtain more plants and further varieties."

Application for seedlings should be addressed to the Agriculturist, S.S. and F.M.S.

F.G.S. (5-12-23)

---

(2) THE FLOWERING OF TUBA. *DERRIS ELLIPTICA*, BENTH.

It has often been a matter of comment that *Derris elliptica* is rarely seen to flower in the Malay Peninsula. As a young plant flowered recently at the Experimental Plantation, Serdang, it is thought worthy of record.

Derris elliptica is deciduous, losing the majority of its leaves during February and early March. In this instance the flowers were borne during the latter part of March, when the new foliage had begun to appear. The raceme is about seven inches long and covered with minute hairs. The individual flowers are pale rose-pink, turning to buff as they age, and about an inch long. The flowers soon fell and no seed was produced.

J.N.M. (9-4-23).

---

(3) BULRUSH MILLET.

(*Pennisetum typhoideum* ; Ekur Kuching (M), Kambu (T)).

Four small plots of this valuable foodstuff were planted at Kuala Kangsar during June. The results have been distinctly encouraging ; the yields, so far as can be estimated, being well up to the Indian standard.

Unfortunately great damage was done to two of the plots by fowls, but the results obtained seem to indicate planting out from a nursery as the better method of cultivation.

No insect pests were observed and birds, with the exception of the fowls mentioned above, were kept away by pieces of cloth on bamboos.

The grain matured very uniformly in about 73 days from sowing. A further series of tests is now in progress.

J.M.H. (9-10-23).

---

(4) GROUND-NUT CAKE FOR HORSES.

Trials of this cake as a horse-feed were carried out at Kuala Kangsar, with the kind co-operation of H.H. the Sultan of Perak, during July and August, 1923.

Mr. T. V. Welsh, who conducted the trials, found that the cake, obtained from Sweet Kamiri Estate, was very successful at the outset. It is easily powdered, an advantage over most cakes, can be intimately mixed with the ordinary feed, and is liked by the ponies. The first trial was carried out on a horse in poor condition that normally would have been put on condition-powders. The cake was fed at the rate of ½ lb. per feed in each of three feeds daily. In the course of two weeks the pony had improved very much, and was eating well-which had not previously been the case.

The next trial was made on four horses, but by this time the cake had lost its freshness and there was a suspicion of mouldiness, the results being less satisfactory.

It is thought that the mouldiness to which this cake is subject may be overcome by admixture with molasses, and it is hoped to carry out some experiments to this end.

In the meanwhile it is recommended that cake for feeding horses or cattle be bought in quantities sufficient for a week on ten days only, and should be guaranteed fresh when bought.

J.M.H. (27-9-23).

CATTLE BREEDING.*

By William Smith.

Imperial Dairy Expert.

[*Reprinted from "The Agricultural Journal of India," Vol. XVIII, Part VI.*]

I am aware that the Committee now sitting in Poona is one mainly concerned with cattle breeding as it specially affects the Presidency of Bombay, but I am sure the Committee will not object to my dealing with the matter from an all-India point of view and on general lines.

I think it is well in dealing with a subject like this to endeavour as far as possible to state—

(1) The present condition of the industry,

(2) Causes of existing condition, and

(3) Steps to be taken to improve existing conditions.

As regard (1), I have now been in India for sixteen and a half years during the whole of which time I have been in very close touch with the cattle breeding industry in the Punjab, the United Provinces, Central Provinces, Sind, Bombay and Madras, and it is my considered opinion that in these parts of the country the quality of the cattle has declined since I came to India, or to put it more definitely, I believe that, generally speaking, it is impossible in the open market to-day to procure in quantity, no matter what the price may be, as good draught bullocks and milch cows as were obtainable 16 years ago. Most certainly the quality of milch cattle available in India, except in the district of Sind, is very much worse than those available 16 years ago. If that be so, it behoves us to look for the reason for such a decline at a time that practically every other country in the world has been able to improve the quality of its cattle, and the root reason undoubtedly is want of knowledge, accentuated by many circumstances such as the spread of irrigation canals and conversion of forest lands with consequent diminution of grazing areas, the increased facilities for transport and consequent mixing of breeds or types, increased prices for human foodstuffs, and the deliberate and erroneous teaching by the departments responsible for cattle breeding that the development of dairying or milk production would injure the draught quality of working bullocks. I look upon it that the wilful elimination of milking qualities in the stud bulls issued by Government for breeding purposes and the persistent teaching of all concerned in cattle breeding for many years in India that dairying or heavy milking qualities of dams are injurious to the qualities of plough cattle have probably done more

* Note submitted to the Bombay Cattle Committee, 1922.

harm to cattle breeding in India than anything, because this elimination of milk-giving qualities strikes at the root of the whole industry. So little attempt has been made to develop milking quality of most breeds of Indian cows that the dams even of some of the finest breeds of cattle are unable to suckle their young within a reasonable time, which means later maturity and fewer calves during the lifetime of the dam.

In times past this did not matter so much, as great breeding areas were available which were useless for any other purpose, but these areas now grow cotton, or pulse, or wheat, and what must take their place. The ordinary cultivator must take their place, and to enable him to do this profitably he must have a cow which will give sufficient milk and ghi (clarified butter) for his family and at the same time rear a good draught bullock. As things are now, the cultivator in India keeps one or two or three cows which can hardly produce enough milk for their calves, and he keeps a female buffalo to give milk and ghi for his family. This female buffalo is quite unnecessary if the breeder can get a cow which will rear the calf and in addition provide the breeder with milk and ghi. Nothing is more certain than that the dam of any type or class of good working bullock whatever can and ought to be a first class milker. We hear many people say that the solution of the cattle breeding problem is to grow more fodder but that is putting the cart before the horse. What we want is fewer but more efficient cattle. No country in the world can afford to keep a cow which is only capable of suckling a calf. The enormous increase in the number of buffaloes in India is the cause of the fodder shortage, because not only is the female buffalo used because the cow is such an inefficient milker, but the male buffalo is often permitted to survive. This male is useless for draught in most parts of the country, and between the female buffalo used because the cow is not as good a milker as she might be and the useless male buffalo the country is drained of its fodder to such an extent that there is not sufficient for any class of cattle.

The solution of the whole matter lies in the dual purpose animal. No matter what class or type of male plough bullock is required, the dam must always be a good milker, and all bulls issued for stud purposes must be got from heavy milkers as well as be of the right size, type and class.

This country can produce all the draught cattle it needs, more than all the dairy produce it can consume from much fewer cattle than we now possess, but they must be more efficient cattle and they must be *dual purpose* every time. Any propaganda outside of *dual purpose* efficiency is only perpetuating a great economic evil. No other basis can be profitable.

If these are the reasons for the present state of affairs, then the first steps to remedy matters is dairy education. In every civilized country in the world to-day dairying occupies a very prominent position in its Agricultural Department. There is not, at the present moment, a single dairy school in India. The crying need of this country agriculturally is dairy education, both of the cultivator and

masses. Not only is the education of the man in the street necessary from the cattle breeding point of view, but it is necessary from the point of the health and general well-being of the people. The milk supply of our cities is probably the worst and most expensive in the whole world, which fact in itself is a proof of the crying need of the dual purpose cow. We do not need beef and the country does not want it, but milk and draught we must have and it is indisputable that these qualities can and must be conserved in the cow of the future.

In this now I, of course, have not touched details of any kind but have confined myself to basic policy, because and until we have our policy based on sure economic foundation we can do nothing. The only practical and sound cattle breeding policy is dairying plus draught qualities; the one is hopeless without the other and both are inseparable.

PROPOSED RUBBER RESEARCH INSTITUTE.

DURING the month of August, 1923, a Provisional Committee was appointed by the Government under the Chairmanship of the Secretary for Agriculture, Straits Settlements and Federated Malay States, to consider certain points that had arisen in connection with the proposal to proceed with the formation of a Rubber Research Institute.

The personnel of the Committee was as follows:—

Secretary for Agriculture, S.S. and F.M.S. (Chairman);
Secretary to High Commissioner;
Mr. R. J. B. Clayton (District Officer, Lower Perak);
Mr. R O. Bishop, Ag. Agricultural Chemist (in the absence of Major Eaton);
The Chairman of the Planters' Association of Malaya;
The Chairman of the Malay Peninsula Agricultural Association;
The Chairman of the Rubber Producers' Association of Malaya;
The Hon'ble Mr. J. M. Campbell;
The Hon'ble Mr. C. Ritchie;
The Hon'ble Mr. Choo Kia Peng;
Mr. S. Wierman.
Mr. H. C. Pinching (Senior Scientific Officer, R.G.A.).

The Committee was instructed to give particular attention to the following questions:—

(*a*) Whether there should be an official or unofficial majority on the Board.

(*b*) Chairmanship of the Board.

(*c*) Representation of the Planters' Association of Malaya.

(*d*) Provisions of funds in the initial stages, and whether and to what extent the duty on rubber under the Export of Rubber (Restriction) Enactment should be utilised for the purposes of the Institute.

A meeting was held at Kuala Lumpur during the month of October, and the Report of the Committee was subsequently forwarded to the Federated Malay States Government which it is understood has the Committee's suggestions under consideration.

The Secretary to the Committee was Mr. C. Ward Jackson, and at their meeting the thanks of the Committee were expressed to him for undertaking the work.

Received for publication 17*th December*, 1923.

BRIEF RECOMMENDATIONS REGARDING RICE MILLING FOR PADI PRODUCERS AND EMPLOYERS OF LABOUR.

The following circular was distributed in September to all District Officers and to some estates :—

AS agriculture is tending to take a progressively more important position in the industrial life of Malaya, more attention must be paid to the fundamental requirements of our agriculturists and the labouring classes.

Amongst our agricultural pursuits, the production of rice is of premier importance, for rice is the staple food of the country and on its price all other industries depend.

Malaya is highly favoured in being situated near a cheap and abundant source of supply of rice, but available rice land is diminishing in proportion to increase of population in most rice producing countries, and our chief source of supply at present cannot be reckoned as permanent. **Therefore it is incumbent upon all classes who have the interests of the country at heart, to encourage the extension of our rice fields and thus help to reduce our huge annual expenditure on imported rice.**

Local rice is more wholesome than any grade of imported rice and on this account employers of labour should show their patriotism by demanding more locally grown rice. Another way in which employers of labour can encourage local production is to purchase padi in place of rice and mill the padi under their own supervision. These notes, based on local experience, are compiled to assist padi producers, employers of labour and others who may wish to mill padi to decide on the form of mill most suitable for use under different circumstances.

A.—Districts which produce excess padi in good seasons only and where padi is not readily saleable.

The "lesong tangan" and "lesong kaki" are well known amongst padi cultivators in Malaya and are invaluable for use by agriculturists who require to mill for their own daily needs only. In certain districts and in good seasons the production of padi exceeds the requirements of the district or of the family and as a ready sale for padi within the district is often not possible, the padi has to be exported long distances for sale. In place of exporting padi to towns for sale, much labour and expense in transit can be saved if the padi is first milled because the proportionate volume of rice is less than 50 per cent. of the bulk of the padi and the weight of the rice from any volume of padi is approximately 63 per cent. of the weight of the padi. Thus, by converting the padi into rice a saving is effected in the number

of bags required, in freight charges, in porterage and in bullock cart costs or often the rice can be sold to local estates which would not purchase padi.

Under these conditions the best method of milling the padi if no source of power is available, is to use the "kisaran." The "kisaran" can mill about 20 gantangs of padi in an hour, that is, it mills 6-7 times more rapidly than the "lesong tangan." Moreover, rice milled by the "kisaran" is much less broken than that milled by the "lesong tangan."

In Krian district a "kisaran" costs $25 including freight to Parit Buntar Station, but there is no reason why this mill cannot be made anywhere in Malaya once a model one is obtained as a sample. The mill is described in the *Malayan Agricultural Journal*, Volume XI, No. 6, 1923. The reason why they should be made on the spot is that the chief material (white ant clay) from which they are made is brittle when dried and liable to crack and crumble if roughly handled on the railway or in transit by other means.

The chaff can be separated from the rice after milling, by hand, using the "niru" or by making use of a steady breeze, but the readiest method is to use a box winnowing machine ("pengipas"). The "pengipas" simply consists of a box in which a fan is rotated by hand to create the breeze necessary to blow away the chaff from the mixture of rice and chaff which is poured in a steady stream through the breeze. Two coolies can winnow 200 gantangs an hour by using this machine, which costs about $33 in Krian, but can easily be made by any Chinese "tukang."

B.—DISTRICTS IN WHICH A REGULAR SUPPLY OF PADI IS AVAILABLE AND WHERE SOURCES OF POWER EXIST.

This category refers mainly to large producing areas where the producers always have a large quantity of padi for sale at harvest.

The surplus produce grown on these areas is generally purchased by commercial millers who dispose of the rice to wholesale dealers and employers of labour. It is this latter class who can benefit most under these circumstances and even make a profit by installing their own small power mills and operating them with the power supplied from existing rubber machinery. For instance, the manager of a rubber estate situated in or near such an area, can purchase padi directly from the growers, mill it and retail it to his coolies to their advantage and with profit to the estate. The best machine in this instance is one of the "Engleburg" type. This type of machine is made by several firms of which the best known are Messrs. Douglas & Grant and Messrs. McKinnon, both of Scotland. The mill may be obtained through Messrs. McAlister & Co., who have branches in the larger towns of Malaya, or through Messrs. Guthrie & Co., or Messrs. R. Young & Co., of Penang. It is sold under various names, "The Planters' Mill," the "Engleburg Huller," the "British Rice Huller," etc., and the cost and power required depends on the size since it is made in several sizes. The type recommended is the Planters' Mill No. 1 which costs $650 locally at present (this price including a stout iron stand) and requires about 7 B. H. P. for

efficient driving. It is compact, sound and simple in construction, and the wearing parts are easily replaced.

The optimum speed is 500 revolutions per minute. At this speed the mill outturn of rice should reach about one hundred gantangs (700 lbs.) per hour, unless the padi is insufficiently dry or is of poor quality when it may be necessary to mill it twice, thus reducing output to about 60 gantangs per hour. The mill works quite well at slower speeds also but more breakage results and usually a few grains of padi escape unhulled.

The mill is equally effective with raw and with parboiled padi, the only difference being that slightly more breakage of the rice is experienced in milling raw padi. The rice produced is not rendered deleterious from the point of view of "beri-beri" disease since the milling is limited to hulling, no polishing of the grain being effected. The cost of erecting this mill should be small unless a separate mill room is required. The cost of fitting the machine to existing rubber machinery would vary according to the length of belting and the number of pulleys required and whether any additional shafts were necessary. A drying-floor is advisable since the padi must be thoroughly dry before being milled otherwise the percentage of broken rice is certain to be high. If parboiled rice is desired a drying-floor is a necessity. (For particulars of parboiling, *see M. A. J.* Vol. XI, No. 6, page 153).

Another form of this machine includes a polishing drum. This form may also be used with safety from the point of view of beri-beri, though it is better to remove half of the polishing flanges from the inside of the polishing drum.

C.—Districts in which a regular supply of padi is available, but where conditions do not include power.

The best machine in this instance is the improved hand-power rice huller shipped by Messrs. Douglas & Grant, and obtainable locally through the Agents mentioned under B. This mill is a combined huller and winnower. It is simple in design, very compact, easily adjusted, strongly constructed and practically "foolproof." The hopper is fitted with an efficient adjustable feeder which delivers the padi to the hulling discs in an even stream and a neat winnowing attachment blows away all the husks after hulling. The resulting rice is very wholesome and free from any injurious effects from the point of view of "beri-beri." This mill is eminently suitable for small estates not requiring a large amount of rice daily, as its outturn is only 15 gantangs of rice per hour, and the hand labour involved in working it is very light. The machine might also be fixed to a motor cycle pulley as the power required is very small since one man can easily work the mill. Before milling, care must be taken that padi is free from stones, nails or other hard particles which are liable to damage the grinding surfaces. The mill costs $100 and spare parts are readily available.

Should the padi obtained for milling be very mixed or imperfectly dry it will probably be necessary to pass the padi through the mill, then separate the escaped padi from the rice, and remill the padi. The quickest and easiest method of effecting this separation of rice from padi is to run the mixture down an inclined sheet of "battery screening" of three-sixteenth inch mesh, when the rice will drop through the screening whereas the padi will run down the incline and can be collected at the bottom. If the padi is mixed it may be necessary to run it down the "separator" three times.

(Particulars of this separator can be had on application to the Economic Botanist, Department of Agriculture, Kuala Lumpur).

H. W. JACK,

Economic Botanist, Department of Agriculture,
S.S. & F.M.S., Kuala Lumpur.

KUALA LUMPUR,
Dated, 12th September, 1923.

LONDON MARKET PRICE LIST, 4th QUARTER 1923.

Oil Seeds.

Castor (Bombay)	-	£20—£21.15 per ton.
Coconut (desiccated)	-	43/6—44/6 per cwt.
Copra (Ceylon)	-	£29.10 per ton.
Do. (Straits)	-	£27.10 „ „
Cotton (Egyptian)	-	£11.5- £11.10 per ton.
Do. (Bombay)	-	£9—£10 per ton.
Croton		27/6—32/6 per cwt.
Gingelly (Chinese)	-	£23.5—£24.10 per ton.
Do. (Bombay)	-	£24.10 per ton.
Groundnuts (Gambia) (undecorticated)	-	£17.2.6 „ „
Do. (Chinese) (decorticated)	-	£21.12.6—£22.5 per ton.
Linseed (Bombay)	-	£22.5 per ton.
Do. (Plate, New Crop)	-	£16.12.6—£17.5 per ton.
Palm Kernels (West Africa)	-	£18.10 per ton.

Oils.

Castor (Madras)	-	49/- per cwt.
Do. (Pharmaceutical)	-	58/- „ „
Do. (1st pressing)	-	53/- „ „
Do. (2nd pressing)	-	52/- „ „
Coconut (Cochin)	-	50/- „ „
Do. (Ceylon)	-	44/- „ „
Cotton seed (Egyptian, crude)	-	37/6 „ „
Do. (Bombay)	-	36/6 „ „
Groundnut (Oriental, crude)	-	48/6 „ „
Do. (English)	-	48/- „ „
Linseed (Calcutta)	-	42/6 „ „
Do. (Plate)	-	41/6 „ „
Palm (Lagos)	-	£36.15 per ton.
Do. (Congo)	-	£36 per ton.
Palm Kernel	-	38/- per cwt.

Oil Cakes.

Coconut	-	£7.15—£8.10 per ton.
Cotton	-	£6.10—£6.15 „ „
Groundnut (undecorticated)	-	£9.5 per ton.
Linseed	-	£11.15 per ton.
Palm kernel	-	£6.5 „ „

Essential Oils.

Cajeput	-	3/3 per lb.
Camphor (Chinese, crude)	-	3/3 „ „
Do. (Japanese, refined)	-	3/9 „ „
Do. (oil)	-	72/6 per cwt.
Cinnamon (Ceylon, leaf)	-	4½d. per oz.
Citronella (Ceylon)	-	4/6 per lb.
Do. (Java)	-	4/7 „ „

Essential Oils—*Contd.*

Clove	-	9/- per lb.
Lemon (Grass Cochin)	-	2½d. per oz.
Lime (West Indian, expressed)	-	7/- per lb.
Do. (do. distilled)	-	4/- ,, ,,
Nutmeg	-	4/3 ,, ,,
Patchouli (Penang)	-	30/-,, ,,
Vetiver (Bourbon)	-	25/-,, ,,

Spices.

Capsicums (East Indian)	-	40/-—45/- per cwt.
Do. (Nyassaland)	-	60/-—65/- ,, ,,
Chillies (Zanzibar)	-	40/-—45/- ,, ,,
Do. (Nyassaland)	-	50/-—53/- ,, ,,
Do. (Japan)	-	125/- per cwt.
Cinnamon (Ceylon)	-	8½d.—11½d. per lb.
Cloves (Zanzibar)	-	1/3½—1/5 ,, ,,
Do. (Penang)	-	2/6—3/- ,, ,,
Ginger (Japanese, Cochin)	-	70/-—80/- per cwt.
Do. (Jamaica)	-	150/-—185/- per cwt.
Mace (Bombay and Penang)	-	1/6—2/- per lb.
Nutmegs (Singapore and Penang)		
110's	-	11½ per lb.
80's	-	1/2 ,, ,,
64's—57's	-	1/7—1/8 per lb.
Pepper (Singapore, black)	-	4d. per lb.
Do. (do. white)	-	6d. ,, ,,
Turmeric (Bengal)	-	65/- per cwt.

Drugs.

Areca	-	45/- per cwt.
Cocaine (hydrochloride)	-	16/6 per oz.
Ipecacuanha (Matto Grosso)	-	7/3 per lb.

Natural Dyestuffs and Extracts.

Annatto (seed)	-	11d.—1/- per lb.
Gambier (block)	-	45/- per cwt.
Do. (cubes)	-	62/6—65/- per cwt.

Gums.

Damar (Singapore)	-	30/-—150/- per cwt.
Do. (Batavia)	-	120/-—160/- ,, ,,
Dragon's blood (reeds)	-	£18—£20 ,, ,,
Do. (lump)	-	£11—£28 ,, ,,

Fibres.

Cotton (F. M. American)	-	19.60d. per lb.
Do. (Egyptian Sakellaridis)	-	21.10d. ,, ,,
Hemp (African sisal)	-	£35.15 per ton.
Do. (Manila, J. Grade)	-	£33 ,, ,,
Kapok (Java)	-	1/2½ per lb.
Do. (Indian)	-	11d. ,, ,,

Foodstuffs.

Cocoa (Ceylon plantation)	-	60/-—105/- per cwt.
Coffee (Malay, plantation)	-	70/-—100/- „ „
Do. (Malay, Liberian)	-	60/-— 65/- „ „
Sago (pearl)	-	24/-— 30/- „ „
Do. (flour)	-	16/-— 17/- „ „
Sugar (white, Java)	-	52/6 per cwt.
Tapioca (Penang flake)	-	3½—3¾ per lb.
Do. (Penang flour)	-	18/-—22/ per cwt.

Miscellaneous Chemicals.

Acetic acid (glacial)	-	£73—£74 per ton.
Do. (80% comml)	-	£48—£49 „ „
Acetone (pure)	-	£127—£130 per ton.
Ammonia (.880)	-	£33—£34 „ „
Calcium acetate (grey)	-	£21.10—£22.10 per ton.
Citric Acid	-	1/5 per lb.
Creosote	-	9½d. „ „
Formalin (40% vol.)	-	£64—£65 per ton.
Lime juice (raw)	-	1/9—2/6 per gallon.
Do. (concentrated)	-	£22 per basis[1]
Sodium bisulphite, 60—62%	-	£21—£23 per ton.
Sodium sulphite (anhydrous)	-	£25—£26 „ „

[1] Basis = 108 gallons, 64 ozs. Citric acid per gallon.

Received for publication 13*th December*, 1923.